Comparative Analysis of CUDA and OpenCL for Electromagnetics Simulations using FDTD

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With the increasing use of general purpose graphical processing units (GP-GPU) for the general purpose computation it had become necessary to critique the available technologies for achieving the best possible performance along with portability.

Recent work uses compute unified device architecture (CUDA) and FORTRAN programming languages for the finite-difference time-domain (FDTD) simulation. In this paper we try to leverage this work and implement CUDA and open computing language (OpenCL) to analyze the simulation performance while achieving portability and liberty to choose different hardware vendor. The OpenCL implementation was compared with the other, popular, parallel programming technique CUDA, which exploits the (hyper) parallel processing of GP-GPU, with respect to the execution speed, memory efficiency and portability. At the first stage the two implementations were executed with no optimization, either related to memory management or specific to hardware. The performance analysis of this implementation revealed that on an average CUDA performed better by processing about 2.8% Millions cells per second more than OpenCL.

In the second stage, some optimization techniques like using the shared memory and data reusability were implemented. The post optimization analysis of the results is also presented. The grid sizes for the analysis varied from 1 to 32 mega cells. The use of multi-cores of the CPUs for a similar implementation is also considered with its performance analysis along with the portability and scalability for different GPUs and CPUs. This work takes a step further towards utilizing a clustered network of GPUs and CPUs forming a heterogeneous environment. This will allow us to perform intensive computational electromagnetics on GPUs and CPUs instead of relying on supercomputers and specially designed field-programmable Gate Arrays (FPGA).